

CLAIMS

What is claimed is:

1 1. A process of forming an optical subassembly in an integrated circuit, the
2 process comprising:
3 defining electrically conducting lines and bonding pads in a metallization layer on
4 a substrate;
5 depositing a passivation layer over said metallization layer;
6 etching said passivation layer to remove said passivation layer from each of said
7 bonding pads and a portion of said metallization layer associated with each of said
8 bonding pads;
9 diffusing Cr from said lines proximate said bonding pads to prevent solder
10 wetting down lines;
11 bonding an optical device to one of said bonding pads; and
12 attaching said substrate to a carrier utilizing solder bond attachment.

1 2. The process according to claim 1 further comprising:
2 obtaining a carrier having a cavity on a first side of said carrier, said cavity
3 configured to provide clearance for said optical device depending from said substrate;
4 and
5 attaching a mini ball grid array (mini-BGA) on said first side.

1 3. The process according to claim 2 further comprising attaching a ball grid array
2 (BGA) on a second side of said carrier for subsequent mounting of said optical
3 subassembly.

1 4. The process according to claim 3 further comprising:
2 aligning said mini-BGA of said carrier with a portion of said bonding pads
3 designated to receive said mini-BGA on said substrate; and
4 joining said carrier to said substrate utilizing a fluxless process to keep said
5 optical device clean.

1 5. The process according to claim 1, wherein subsequent attaching components to
2 the subassembly utilizes a temperature hierarchy to prevent movement of said optical
3 device relative to said substrate, and said substrate relative to said carrier when said
4 subassembly is heated for said subsequent attaching.

1 6. The process according to claim 1, wherein said bonding pads allow for wire
2 bond attachment and solder bond attachment.

1 7. The process according to claim 1, wherein said forming of said metallization
2 layer comprises:
3 depositing a first Cr layer;
4 depositing a Cu layer;
5 depositing a Ni layer;
6 depositing a Au layer; and
7 depositing a second Cr layer.

1 8. The process according to claim 7, wherein the first Cr layer thickness is about
2 200 to about 800 Å (angstroms), the Cu layer thickness is about 3 to about 5 μM
3 (microns), the Ni layer thickness is about 2 to about 4 μM (microns), the Au layer
4 thickness is about 0.4 to about 0.7 μM (microns), and the second Cr layer thickness is
5 about 500 to about 1000 Å (angstroms).

1 9. The process according to claim 7, wherein said portion of metallization layer
2 removed is said second Cr layer.

1 10. The process according to claim 1, wherein said passivation layer comprises a
2 material selected from the group consisting of a SiO₂, Si₃Ni₄, polyimide dielectrics and
3 mixtures thereof.

1 11. The process according to claim 1, wherein said passivation layer has a
2 thickness of about 2000 to about 3000 Å (angstroms) when SiO₂ or Si₃Ni₄ is utilized.

1 12. The process according to claim 1, wherein said passivation layer has a
2 thickness of about 2 to about 4 μM (microns) when polyimide is utilized.

1 13. The process according to claim 2, wherein said mini ball grid array (mini-
2 BGA) on either side of said cavity includes solder balls having a melting point of about
3 240°C .

1 14. The process according to claim 13, wherein said joining said carrier to said
2 substrate includes reflowing of said solder balls by a fluxless process.

1 15. The process according to claim 14, wherein said fluxless process includes
2 one of:
3 reflowing in H₂ gas , and
4 ionizing fluorinated gases in a plasma chamber and reacting with Sn-rich
5 surfaces to enhance wetting of molten Sn-rich solder to said bonding pads on said SiOB.

1 16. The process according to claim 3, wherein said BGA include solder balls
2 having a melting point of about 183°C.

1 17. The process according to claim 1, wherein said one of said bonding pads for
2 said optical device comprises an area array of flip-chip bond pads.

1 18. The process according to claim 2, wherein surface mount technology (SMT)
2 devices are mounted on said first side of said carrier.

1 19. An optical subassembly comprising:
2 a carrier having a first side and a second side;
3 a ball grid array (BGA) depending from said second side;
4 a cavity disposed in said first side,
5 a silicon optical bench (SiOB) having an optical device mounted thereon,
6 said SiOB is electrically and mechanically connected to said first side utilizing surface
7 mount technology (SMT) attachment, said cavity providing clearance for said optical
8 device when connecting said SiOB to said carrier, said SiOB having a metallization layer
9 providing both wire bondable and solder bondable pads.

1 20. The subassembly according to claim 19, wherein said first side includes a
2 SMT device depending therefrom.

1 21. The subassembly according to claim 17, wherein said SMT attachment
2 comprises a mini-ball grid array (mini-BGA) depending from said first side, said mini-
3 BGA intermediate said SiOB and said carrier for electrical and mechanical connection
4 therebetween.

1 22. The subassembly according to claim 19, wherein said mini-BGA comprises a
2 plurality of solder balls having a melting point of about 240°C.

1 23. The subassembly according to claim 22, wherein said solder balls have a
2 diameter of about 0.25 to about 0.50 mm.

1 24. The subassembly according to claim 22, wherein said solder balls have a
2 Sn/Sb composition, said Sb composition being about 5 to about 10 percent.

1 25. The subassembly according to claim 19, wherein said optical device is
2 mounted to said SiOB having an area array of flip-chip pads with solder bumps.

1 26. The subassembly according to claim 19, wherein said metallization layer
2 comprises:

- 3 a first Cr layer deposited;
4 a Cu layer;
5 a Ni layer;
6 a Au layer; and
7 a second Cr layer.

1 27. The subassembly according to claim 19, wherein said mini-BGA, said
2 optical device, and any SMT device depend from said Au layer.